

Application No. 10/827,097
Amendment and Response Dated January __, 2006
Reply to Office Action dated October 18, 2005

AMENDMENTS TO THE CLAIMS

1. (currently amended) A method of ink jet printing UV curable ink on a substrate that may be formed of a heat sensitive rigid or other material, the method comprising:

moving a printhead carriage having an ink jet printhead thereon approximately parallel to a substrate;

jetting ink from the [[heads]] printhead across [[the]] a predetermined distance onto the surface of a substrate;

providing at least one cold UV curing assembly on the carriage oriented to direct UV energy onto the surface of the substrate sufficiently close to where ink is being jetted onto the surface so as to freeze dots of the jetted ink on the surface; and

the cold UV assembly being effective to impinge sufficient UV energy on the jetted ink to substantially cure the jetted ink without impinging sufficient radiation of other wavelengths that would heat the substrate so as to deform it while the substrate is under the printhead.

Claims 2-8 (previously canceled)

9. (previously amended) An ink jet printing apparatus for printing with UV curable ink on a substantially rigid substrate having a tendency to deform toward the printhead when heated, the apparatus comprising:

a substrate support defining a substrate supporting plane;

a printhead track extending parallel to the plane having a printhead carriage moveable thereon;

at least one ink jet printhead on the carriage;

at least one cold UV curing head on the carriage sufficiently close to the ink jet printhead to freeze dots of ink in position on the substrate when jetted thereon from the printhead;

the UV curing head being configured to emit sufficient UV energy to at least partially cure the ink jetted onto the substrate without heating and thermally deforming the substrate.

Claims 10-11 (previously canceled)

Application No. 10/827,097
Amendment and Response Dated January __, 2006
Reply to Office Action dated October 18, 2005

12. (previously amended) The apparatus of claim 9 wherein:

the at least one UV curing head includes at least two cold UV curing heads, one positioned on the carriage at each side of the printheads so that one leads the printheads and one trails the printheads as the carriage moves on in either of two opposite directions on the track; and

the controller is operable to activate at least one of the UV curing heads to expose the ink jetted by the printheads on the surface of the substrate.

Claim 13 (previously canceled)

14. (previously amended) The apparatus of claim 9 further comprising:
a heating station positioned so as to heat UV light exposed ink on a substrate.

15. (previously presented) The apparatus of claim 14 wherein:

the heating station includes a blower oriented to direct heated air onto a substrate on the support.

Claims 16-18 (previously canceled)

Claims 19-26 (canceled)

27. (previously presented) A method of dispensing UV curable ink from a printhead onto a substantially rigid substrate formed of a material that has a tendency to deform at least temporarily if exposed to radiant energy, the method comprising:

moving a printhead approximately parallel to a substrate at a printing station;

dispensing ink from the printhead onto a surface of the substrate; and

providing at least one cold UV curing assembly moveable with the printhead and configured to direct UV radiation onto the surface of the substrate to freeze the dispensed ink on the surface of the substrate and to substantially cure the ink without impinging radiation that would materially deform the substrate while the substrate is at the printing station.

28. (currently amended) The method of claim 27 wherein:

Application No. 10/827,097
Amendment and Response Dated January __, 2006
Reply to Office Action dated October 18, 2005

the cold UV curing assembly is effective to substantially cure the jetted ink without impinging sufficient radiation of non-UV wavelengths that would substantially deform the surface of the substrate where the ink is being jetted while ink is being jetted onto the surface of the substrate.

Claims 29 and 30 (canceled)

31. (currently amended) An ink jet printing apparatus for printing upon a substrate, the ink jet printing apparatus comprising:

a vacuum table configured to hold a substrate to the table;

a printhead carriage;

a printhead coupled to and movable with the printhead carriage to different positions with respect to the substrate; and

a cold UV curing head coupled to and movable with the printhead carriage and configured to direct an amount of UV energy toward the substrate, the amount of UV energy sufficient to [at least partially] substantially cure ink dispensed from the printhead upon the substrate, but insufficient to substantially thermally deform the substrate when a vacuum is applied from the vacuum table.

32. (previously presented) The apparatus of claim 31 wherein:
the substrate is foamboard.

33. (canceled)

34. (previously presented) The apparatus of claim 31 wherein the cold UV curing head includes a limited bandwidth UV source.

35. (currently amended) The apparatus of claim 31 wherein the cold UV curing head comprises:

at least one UV lamp fixed relative to the printhead that emits UV light;

Application No. 10/827,097
Amendment and Response Dated January __, 2006
Reply to Office Action dated October 18, 2005

a reflector having a surface configured to direct UV light onto the substrate from behind the at least one UV lamp; and
a fluid cooling system coupled to the reflector.

36. (currently amended) ~~The apparatus of claim 35 wherein the cold UV curing head further comprises An ink jet printing apparatus for printing upon a substrate, the ink jet printing apparatus comprising:~~

a printhead carriage;
a printhead coupled to and movable with the printhead carriage to different positions with respect to the substrate; and
a cold UV curing head configured to direct an amount of UV energy toward the substrate, the amount of UV energy sufficient to at least partially cure ink dispensed from the printhead upon the substrate, but insufficient to substantially thermally deform the substrate, the cold UV curing head including
at least one lamp fixed relative to the printhead that emits UV light;
a reflector having a surface configured to direct UV light onto the substrate from behind the at least one lamp;
a fluid cooling system coupled to the reflector; and
a hollow tube, substantially transparent to UV radiation, substantially absorbent of infrared radiation, and formed of a temperature and radiation tolerant material, the tube extending the length of the head and being positioned between the at least one lamp and the substrate.

37. (previously presented) The apparatus of claim 36 wherein the cold UV curing head further comprises:

a second fluid cooling system coupled to the tube to remove heat energy from infrared radiation by the tube.

38. (previously presented) The apparatus of claim 31 wherein the cold UV curing head comprises:

at least one lamp fixed relative to the printhead that emits UV light;

Application No. 10/827,097
Amendment and Response Dated January __, 2006
Reply to Office Action dated October 18, 2005

the at least one lamp consuming power of at least approximately 125 watts per linear inch.

39. (previously presented) The apparatus of claim 31 wherein the cold UV curing head comprises:

at least one lamp fixed relative to the printhead that emits UV light;
the at least one lamp being capable of being operated at a power consumption of at least 200 watts per linear inch.

40. (previously presented) The apparatus of claim 31 wherein the cold UV curing head comprises:

at least one lamp fixed relative to the printhead that emits UV light;
a reflector having a surface configured to direct UV light onto the substrate from behind the at least one lamp; and
a fluid cooling system coupled to the reflector.

Claims 41-44 (canceled)

45. (currently amended) An ink jet printing apparatus for printing upon a deformable substrate, the apparatus comprising:

a printhead carriage;
a printhead coupled to and movable with the printhead carriage to different positions with respect to the deformable substrate and configured to jet ink onto the deformable substrate;
a substrate support vacuum table configured to support the deformable substrate and hold the substrate via a vacuum for printing thereon by the printhead; and

a cold UV curing head on the printhead carriage configured to direct UV energy onto the deformable substrate sufficiently close to where ink is jetted onto the deformable substrate so as to substantially cure the jetted ink toward the substrate;

the cold UV curing head including at least one lamp having a power consumption of at least approximately 125 watts per linear inch; and

Application No. 10/827,097
Amendment and Response Dated January __, 2006
Reply to Office Action dated October 18, 2005

a reflector having a surface configured to direct UV light onto the deformable substrate from behind the at least one lamp.

46. (currently amended) The apparatus of claim 45 wherein the cold UV curing head further comprises An ink jet printing apparatus for printing upon a deformable substrate, the apparatus comprising:

a printhead carriage;

a printhead coupled to and movable with the printhead carriage to different positions with respect to the deformable substrate;

a substrate support table configured to support the deformable substrate for printing thereon by the printhead; and

a cold UV curing head on the carriage configured to direct UV energy toward the substrate;

the cold UV curing head including at least one lamp having a power consumption of at least approximately 125 watts per linear inch;

a hollow tube, substantially transparent to UV radiation, substantially absorbent of infrared radiation, and formed of a temperature and radiation tolerant material, the tube extending the length of the head and being positioned between the at least one lamp and the substrate; and

a second fluid cooling system coupled to the tube to remove heat energy from infrared radiation by the tube.

47. (currently amended) The apparatus of claim 45 wherein the cold UV curing head comprises:

at least one lamp includes two lamps, one on each side of the printhead that emit UV light of at least 200 watts per linear inch, each having a reflector with a surface configured to direct UV light onto the deformable substrate from behind the at least one lamp; and the apparatus further comprises a cooling system configured to take heat away from each reflector.

Application No. 10/827,097
Amendment and Response Dated January __, 2006
Reply to Office Action dated October 18, 2005

48. (currently amended) The apparatus of claim 45 wherein the [[substrate]] vacuum table has vacuum ports therein and a vacuum system coupled to the ports and configured to clamp a deformable substrate to the table.

49. (previously presented) The apparatus of claim 45 wherein the substrate is foamboard.

50. (new) A method of ink jet printing with UV curable ink onto a rigid substrate held by a vacuum to a support surface, the method comprising:

moving a printhead carriage having an inkjet printhead and cold UV assembly thereon substantially parallel to the substrate;

jetting ink from the printhead onto the substrate while the substrate is held by the vacuum; and

directing UV energy from the cold UV assembly onto the substrate while the substrate is held by the vacuum to substantially cure the ink without impinging sufficient energy that would deform the substrate under the printhead so as to adversely affect the quality of the ink jet printing of the substrate.

52. (new) An ink jet printing apparatus for printing upon a substrate, the ink jet printing apparatus comprising:

a vacuum table configured to hold a substrate in place via a vacuum;

a printhead carriage;

a printhead coupled to and movable with the printhead carriage to different positions with respect to the substrate; and

a cold UV curing head coupled to and movable with the printhead carriage and configured to direct energy onto the surface of the substrate sufficiently close to where ink is being jetted onto the surface so as to substantially cure the jetted ink without impinging sufficient energy that would deform the substrate under the printhead when a vacuum is applied from the vacuum table.

53. (new) A method of printing UV curable ink on a heat-sensitive substrate, which comprises:

Application No. 10/827,097
Amendment and Response Dated January __, 2006
Reply to Office Action dated October 18, 2005

moving a printhead carriage having a printhead thereon approximately parallel to a substrate;

dispersing UV curable ink from the printhead onto the substrate;

providing at least one UV curing assembly on the carriage, wherein the UV curing assembly

(a) is configured to emit sufficient UV energy to at least substantially cure the ink dispersed onto the substrate; and

(b) comprises one or more filters capable of preventing at least a portion of undesired energy emitted from the UV curing assembly from contacting the substrate in order to assist in preventing the substrate from deforming to a level that would materially diminish print quality; and

providing a vacuum table for assisting in holding the substrate down and in place.

54. (new) An ink jet printing apparatus for printing UV curable ink on a heat-sensitive substrate, which comprises:

a printhead carriage;

a printhead coupled to and moveable with the printhead carriage;

at least one UV curing assembly coupled to and moveable with the printhead carriage, wherein the UV curing assembly

(a) is configured to emit sufficient UV energy to at least substantially cure the ink dispersed onto the substrate; and

(b) comprises one or more filters capable of preventing at least a portion of undesired energy emitted from the UV curing assembly from contacting the substrate; and

Application No. 10/827,097
Amendment and Response Dated January __, 2006
Reply to Office Action dated October 18, 2005

a vacuum table for assisting in holding the substrate down and in place.